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# Security Council

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## Note by the President of the Security Council

At its 6335th meeting, held on 9 June 2010 in connection with the item entitled "Non-proliferation", the Security Council adopted resolution 1929 (2010).

In paragraph 4 of the resolution, the Security Council requested the Director General of the International Atomic Energy Agency to communicate to the Security Council all his reports on the application of safeguards in the Islamic Republic of Iran.

Accordingly, the President herewith circulates the report of the Director General dated 8 November 2011 (see annex).

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## Annex

### Letter dated 8 November 2011 from the Director General of the International Atomic Energy Agency addressed to the President of the Security Council

I enclose herewith the report requested by the Security Council in its resolution 1929 (2010), which I have submitted today to the Board of Governors of the International Atomic Energy Agency (see enclosure).

I should be grateful if you would bring this letter and the enclosed report to the attention of all members of the Security Council.

(*Signed*) Yukiya **Amano**

**Enclosure***

## Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions in the Islamic Republic of Iran

*Report by the Director General*

## A. Introduction

1. This report of the Director General to the Board of Governors and, in parallel, to the Security Council, is on the implementation of the NPT Safeguards Agreement[1] and relevant provisions of Security Council resolutions in the Islamic Republic of Iran (Iran).

2. The Security Council has affirmed that the steps required by the Board of Governors in its resolutions[2] are binding on Iran.[3] The relevant provisions of the aforementioned Security Council resolutions were adopted under Chapter VII of the United Nations Charter, and are mandatory, in accordance with the terms of those resolutions.[4]

3. By virtue of its Relationship Agreement with the United Nations,[5] the Agency is required to cooperate with the Security Council in the exercise of the Council's responsibility for the maintenance or restoration of international peace and security. All Members of the United Nations agree to accept and carry out the decisions of the Security Council,[6] and in this respect, to take actions which are consistent with their obligations under the United Nations Charter.

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* Circulated to the Board of Governors of the International Atomic Energy Agency under the symbol GOV/2011/65.

[1] The Agreement between Iran and the Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/214), which entered into force on 15 May 1974.

[2] The Board of Governors has adopted ten resolutions in connection with the implementation of safeguards in Iran: GOV/2003/69 (12 September 2003); GOV/2003/81 (26 November 2003); GOV/2004/21 (13 March 2004); GOV/2004/49 (18 June 2004); GOV/2004/79 (18 September 2004); GOV/2004/90 (29 November 2004); GOV/2005/64 (11 August 2005); GOV/2005/77 (24 September 2005); GOV/2006/14 (4 February 2006); and GOV/2009/82 (27 November 2009).

[3] In resolution 1929 (2010), the Security Council: affirmed, inter alia, that Iran shall, without further delay, take the steps required by the Board in GOV/2006/14 and GOV/2009/82; reaffirmed Iran's obligation to cooperate fully with the IAEA on all outstanding issues, particularly those which give rise to concerns about the possible military dimensions of the Iranian nuclear programme; decided that Iran shall, without delay, comply fully and without qualification with its Safeguards Agreement, including through the application of modified Code 3.1 of the Subsidiary Arrangements; and called upon Iran to act strictly in accordance with the provisions of its Additional Protocol and to ratify it promptly (operative paras 1-6).

[4] The United Nations Security Council has adopted the following resolutions on Iran: 1696 (2006); 1737 (2006); 1747 (2007); 1803 (2008); 1835 (2008); and 1929 (2010).

[5] The Agreement Governing the Relationship between the United Nations and the IAEA entered into force on 14 November 1957, following approval by the General Conference, upon recommendation of the Board of Governors, and approval by the General Assembly of the United Nations. It is reproduced in INFCIRC/11 (30 October 1959), Part I.A.

[6] The Charter of the United Nations, Article 25.

4. In a letter dated 26 May 2011, H.E. Dr Fereydoun Abbasi, Vice President of Iran and Head of the Atomic Energy Organization of Iran (AEOI), informed the Director General that Iran would be prepared to receive relevant questions from the Agency on its nuclear activities after a declaration by the Agency that the workplan (INFCIRC/711) had been fully implemented and that the Agency would thereafter implement safeguards in Iran in a routine manner. In his reply of 3 June 2011, the Director General informed Dr Abbasi that the Agency was neither in a position to make such a declaration, nor to conduct safeguards in Iran in a routine manner, in light of concerns about the existence in Iran of possible military dimensions to Iran's nuclear programme. On 19 September 2011, the Director General met Dr. Abbasi in Vienna, and discussed issues related to the implementation of Iran's Safeguards Agreement and other relevant obligations. In a letter dated 30 September 2011, the Agency reiterated its invitation to Iran to re-engage with the Agency on the outstanding issues related to possible military dimensions to Iran's nuclear programme and the actions required of Iran to resolve those issues. In a letter dated 30 October 2011, Dr Abbasi referred to his previous discussions with the Director General and expressed the will of Iran "to remove ambiguities, if any", suggesting that the Deputy Director General for Safeguards (DDG-SG), should visit Iran for discussions. In his reply, dated 2 November 2011, the Director General indicated his preparedness to send the DDG-SG to "discuss the issues identified" in his forthcoming report to the Board of Governors.

5. This report addresses developments since the last report (GOV/2011/54, 2 September 2011), as well as issues of longer standing, and, in line with the Director General's opening remarks to the Board of Governors on 12 September 2011, contains an Annex setting out in more detail the basis for the Agency's concerns about possible military dimensions to Iran's nuclear programme. The report focuses on those areas where Iran has not fully implemented its binding obligations, as the full implementation of these obligations is needed to establish international confidence in the exclusively peaceful nature of Iran's nuclear programme.

## B. Facilities Declared under Iran's Safeguards Agreement

6. Under its Safeguards Agreement, Iran has declared to the Agency 15 nuclear facilities and nine locations outside facilities where nuclear material is customarily used (LOFs).[7] Notwithstanding that certain of the activities being undertaken by Iran at some of the facilities are contrary to the relevant resolutions of the Board of Governors and the Security Council, as indicated below, the Agency continues to implement safeguards at these facilities and LOFs.

## C. Enrichment Related Activities

7. Contrary to the relevant resolutions of the Board of Governors and the Security Council, Iran has not suspended its enrichment related activities in the following declared facilities, all of which are nevertheless under Agency safeguards.

[7] All of the LOFs are situated within hospitals.

## C.1. Natanz: Fuel Enrichment Plant and Pilot Fuel Enrichment Plant

8. **Fuel Enrichment Plant (FEP):** There are two cascade halls at FEP: Production Hall A and Production Hall B. According to the design information submitted by Iran, eight units are planned for Production Hall A, with 18 cascades in each unit. No detailed design information has yet been provided for Production Hall B.

9. As of 2 November 2011, 54 cascades were installed in three of the eight units in Production Hall A, 37 of which were declared by Iran as being fed with $UF_6$.[8] Whereas initially each installed cascade comprised 164 centrifuges, Iran has subsequently modified 15 of the cascades to contain 174 centrifuges each. To date, all the centrifuges installed are IR-1 machines. As of 2 November 2011, installation work in the remaining five units was ongoing, but no centrifuges had been installed, and there had been no installation work in Production Hall B.

10. Between 15 October and 8 November 2011, the Agency conducted a physical inventory verification (PIV) at FEP, the results of which the Agency is currently evaluating.

11. Iran has estimated that, between 18 October 2010 and 1 November 2011, it produced 1787 kg of low enriched $UF_6$, which would result in a total production of 4922 kg of low enriched $UF_6$ since production began in February 2007.[9] The nuclear material at FEP (including the feed, product and tails), as well as all installed cascades and the feed and withdrawal stations, are subject to Agency containment and surveillance.[10] The consequences for safeguards of the seal breakage in the feed and withdrawal area[11] will be evaluated by the Agency upon completion of its assessment of the PIV.

12. Based on the results of the analysis of environmental samples taken at FEP since February 2007[12] and other verification activities, the Agency has concluded that the facility has operated as declared by Iran in the Design Information Questionnaire (DIQ).

13. **Pilot Fuel Enrichment Plant (PFEP):** PFEP is a research and development (R&D) facility, and a pilot low enriched uranium (LEU) production facility, which was first brought into operation in October 2003. It has a cascade hall that can accommodate six cascades, and is divided between an area designated for the production of LEU enriched up to 20% U-235 (Cascades 1 and 6) and an area designated for R&D (Cascades 2, 3, 4 and 5).

14. In the production area, Iran first began feeding low enriched $UF_6$ into Cascade 1 on 9 February 2010, for the stated purpose of producing $UF_6$ enriched up to 20% U-235 for use in the manufacture of fuel for the Tehran Research Reactor (TRR).[13],[14] Since 13 July 2010, Iran has been feeding low enriched $UF_6$ into two

[8] The 54 installed cascades contained approximately 8000 centrifuges; the 37 cascades declared by Iran as being fed with $UF_6$ on that date contained 6208 centrifuges. Not all of the centrifuges in the cascades that were being fed with $UF_6$ may have been working.

[9] The Agency previously verified that, as of 17 October 2010, a total of 3135 kg of low enriched $UF_6$ had been produced since the start of operations in February 2007 (GOV/2011/29, para. 9).

[10] In line with normal safeguards practice, small amounts of nuclear material at the facility (e.g. some waste and samples) are not subject to containment and surveillance.

[11] GOV/2011/29, para. 10.

[12] Results are available to the Agency for samples taken up to 6 March 2011.

[13] GOV/2010/28, para. 9.

[14] TRR is a 5 MW reactor which operates with 20% U-235 enriched fuel and is used for the irradiation of different types of targets and for research and training purposes.

interconnected cascades (Cascades 1 and 6), each of which consists of 164 IR-1 centrifuges.[15]

15. Between 13 and 29 September 2011, the Agency conducted a PIV at PFEP and verified that, as of 13 September 2011, 720.8 kg of low enriched $UF_6$ had been fed into the cascade(s) in the production area since the process began on 9 February 2010, and that a total of 73.7 kg of $UF_6$ enriched up to 20% U-235 had been produced. The Agency is continuing with its assessment of the results of the PIV. Iran has estimated that, between 14 September 2011 and 28 October 2011, a total of 44.7 kg of $UF_6$ enriched at FEP was fed into the two interconnected cascades and that approximately 6 kg of $UF_6$ enriched up to 20% U-235 were produced.

16. The preliminary results of the PIV show an improvement to the operator's weighing system. Once the assessment of the PIV has been completed, the Agency will be able to determine whether the operator's better sampling procedures have resulted in a more accurate determination of the level of U-235 enrichment.[16]

17. In the R&D area, as of 22 October 2011, Iran had installed 164 IR-2m centrifuges in Cascade 5,[17] all of which were under vacuum, and 66 IR-4 centrifuges in Cascade 4, none of which had been fed with $UF_6$. In Cascades 2 and 3, Iran has been feeding natural $UF_6$ into single machines, 10-machine cascades and 20-machine cascades of IR-1, IR-2m and IR-4 centrifuges.

18. Between 21 August 2011 and 28 October 2011, a total of approximately 59.8 kg of natural $UF_6$ was fed into centrifuges in the R&D area, but no LEU was withdrawn as the product and the tails are recombined at the end of the process.

19. Based on the results of the analysis of the environmental samples taken at PFEP[18] and other verification activities, the Agency has concluded that the facility has operated as declared by Iran in the DIQ.

### C.2. Fordow Fuel Enrichment Plant

20. In September 2009, Iran informed the Agency that it was constructing the Fordow Fuel Enrichment Plant (FFEP), located near the city of Qom. In its DIQ of 10 October 2009, Iran stated that the purpose of the facility was the production of $UF_6$ enriched up to 5% U-235, and that the facility was being built to contain 16 cascades, with a total of approximately 3000 centrifuges.[19]

21. In September 2010, Iran provided the Agency with a revised DIQ in which it stated that the purpose of FFEP was to include R&D as well as the production of $UF_6$ enriched up to 5% U-235.

22. As previously reported, Iran provided the Agency with another revised DIQ in June 2011 in which the stated purpose of FFEP was the production of $UF_6$ enriched up to 20% U-235, as well as R&D. Iran informed the Agency that initially this production would take place within two sets of two interconnected cascades, and that each of these cascades would consist of 174 centrifuges. Iran was reported to

[15] GOV/2010/28, para. 9.
[16] GOV/2011/29, para. 14; GOV/2011/54, para. 15.
[17] Iran had previously indicated its intention to install two 164-centrifuge cascades (Cascades 4 and 5) in the R&D area (GOV/2011/7, para. 17).
[18] Results are available to the Agency for samples taken up to 5 March 2011.
[19] GOV/2009/74, para. 9.

have decided to "triple its (production) capacity", after which Iran would stop the "20% fuel production" at Natanz.[20]

23. On 17 October 2011, as anticipated in its letter to the Agency dated 11 October 2011, Iran transferred from FEP to FFEP one large cylinder containing LEU in the form of $UF_6$ and one small cylinder containing depleted uranium (DU) in the form of $UF_6$. According to Iran, the LEU will be used for feeding and the DU will be used for line passivation. On 24 October 2011, the Agency detached the seal on the cylinder containing the DU, and the cylinder was immobilized at the feeding station. At the request of Iran, the Agency will detach the seal on the cylinder containing the LEU on 8 November 2011, and the cylinder will be immobilized at the feeding station.

24. During an inspection on 23 and 24 October 2011, the Agency verified that Iran had installed all 174 centrifuges in each of two cascades, neither of which had been connected to the cooling and electrical lines, and had installed 64 centrifuges in a third cascade. To date, all the centrifuges installed are IR-1 machines. Iran informed the Agency that the main power supply had been connected to the facility. No centrifuges had been installed in the area designated for R&D purposes.

25. The Agency continues to verify that FFEP is being constructed according to the latest DIQ provided by Iran. As previously reported, although Iran has provided some clarification regarding the initial timing of, and circumstances relating to, its decision to build FFEP at an existing defence establishment, additional information from Iran is still needed in connection with this facility.[21]

26. The results of the analysis of the environmental samples taken at FFEP up to 27 April 2011 did not indicate the presence of enriched uranium.[22]

### C.3. Other Enrichment Related Activities

27. The Agency is still awaiting a substantive response from Iran to Agency requests for further information in relation to announcements made by Iran concerning the construction of ten new uranium enrichment facilities, the sites for five of which, according to Iran, have been decided, and the construction of one of which was to have begun by the end of the last Iranian year (20 March 2011) or the start of this Iranian year.[23,24] In August 2011, Dr. Abbasi was reported as having said that Iran did not need to build new enrichment facilities during the next two years.[25] Iran has not provided information, as requested by the Agency in its letter of 18 August 2010, in connection with its announcement on 7 February 2010 that it possessed laser enrichment technology.[26] As a result of Iran's lack of cooperation on those issues, the Agency is unable to verify and report fully on these matters.

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[20] Dr. Fereydoun Abbasi, 'Iran to Triple Production of 20%-Enriched Uranium', Fars News Agency, 8 June 2011.

[21] GOV/2011/29, para. 20.

[22] The results did show a small number of particles of depleted uranium (GOV/2010/10, para. 17).

[23] 'Iran Specifies Location for 10 New Enrichment Sites', Fars News Agency, 16 August 2010.

[24] GOV/2010/46, para. 33.

[25] 'Iran atomic chief says fuel swap talks over: IRNA', Agence France Press article of 31 August 2011, citing remarks made by Dr Abbasi during an interview with the Islamic Republic News Agency.

[26] Cited on the website of the Presidency of the Islamic Republic of Iran, 7 February 2010, at http://www.president.ir/en/?ArtID=20255 .

## D. Reprocessing Activities

28. Pursuant to the relevant resolutions of the Board of Governors and the Security Council, Iran is obliged to suspend its reprocessing activities, including R&D.[27] In a letter to the Agency dated 15 February 2008, Iran stated that it "does not have reprocessing activities". In that context, the Agency has continued to monitor the use of hot cells at TRR and the Molybdenum, Iodine and Xenon Radioisotope Production (MIX) Facility.[28] The Agency carried out an inspection and design information verification (DIV) at TRR on 15 October 2011, and a DIV at the MIX Facility on 16 October 2011. It is only with respect to TRR, the MIX Facility and the other facilities to which the Agency has access that the Agency can confirm that there are no ongoing reprocessing related activities in Iran.

## E. Heavy Water Related Projects

29. Contrary to the relevant resolutions of the Board of Governors and the Security Council, Iran has not suspended work on all heavy water related projects, including the construction of the heavy water moderated research reactor, the Iran Nuclear Research Reactor (IR-40 Reactor), which is subject to Agency safeguards.[29]

30. On 17 October 2011, the Agency carried out a DIV at the IR-40 Reactor at Arak and observed that construction of the facility was ongoing and the coolant heat exchangers had been installed. According to Iran, the operation of the IR-40 Reactor is planned to commence by the end of 2013.

31. Since its visit to the Heavy Water Production Plant (HWPP) on 17 August 2011, the Agency, in a letter to Iran dated 20 October 2011, requested further access to HWPP. The Agency has yet to receive a reply to that letter, and is again relying on satellite imagery to monitor the status of HWPP. Based on recent images, the HWPP appears to be in operation. To date, Iran has not provided the Agency access to the heavy water stored at the Uranium Conversion Facility (UCF) in order to take samples.[30]

## F. Uranium Conversion and Fuel Fabrication

32. Although it is obliged to suspend all enrichment related activities and heavy water related projects, Iran is conducting a number of activities at UCF and the Fuel Manufacturing Plant (FMP) at Esfahan which, as described below, are in contravention of those obligations, although both facilities are under Agency safeguards.

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[27] S/RES/1696 (2006), para. 2; S/RES/1737 (2006), para. 2; S/RES/1747 (2007), para. 1; S/RES/1803 (2008), para. 1; S/RES/1835 (2008), para. 4; S/RES/1929 (2010), para. 2.

[28] The MIX Facility is a hot cell complex for the separation of radiopharmaceutical isotopes from targets, including uranium, irradiated at TRR. The MIX Facility is not currently processing any uranium targets.

[29] S/RES/1737 (2006), para. 2; S/RES/1747 (2007), para. 1; S/RES/1803 (2008), para. 1; S/RES/1835 (2008), para. 4; S/RES/1929 (2010), para. 2.

[30] GOV/2010/10, paras. 20 and 21.

33. **Uranium Conversion Facility:** On 18 October 2011, the Agency carried out a DIV at UCF during which the Agency observed the ongoing installation of the process equipment for the conversion of $UF_6$ enriched up to 20% U-235 into $U_3O_8$. During the DIV, Iran informed the Agency that the initial tests of this conversion line, originally scheduled to start on 6 September 2011, had been postponed and would not involve the use of nuclear material.

34. As previously reported, Iran informed the Agency in July 2011 that it would start R&D activities at UCF for the conversion of $UF_6$ enriched up to 5% U-235 into $UO_2$. During the aforementioned DIV, Iran informed the Agency that 6.8 kg of DU in the form of $UF_6$ had been processed and that Iran had produced 113 g of uranium in the form of $UO_2$ that met its specifications. According to Iran, this $UO_2$ has been sent to FMP to produce test pellets. Iran has also started using $UF_6$ enriched to 3.34% U-235 to produce $UO_2$. During the DIV, Iran further informed the Agency that this $UO_2$ would also be sent to FMP to produce fuel pellets, which would then be sent to TRR for "performance test studies".

35. In a letter dated 4 October 2011, Iran informed the Agency of the postponement of the production of natural $UF_6$, involving the use of uranium ore concentrate (UOC) produced at the Bandar Abbas Uranium Production Plant, originally scheduled to restart on 23 October 2011. In a letter dated 11 October 2011, Iran informed the Agency that, from 11 November 2011, it intended to use UOC produced at the Bandar Abbas Uranium Production Plant for the production of natural uranium in the form of $UO_2$. During the DIV on 18 October 2011, the Agency took a sample of this UOC. During the same DIV, Iran informed the Agency that, since 23 July 2011, it had fed into the process 958.7 kg of uranium in the form of UOC[31] and produced about 185.6 kg of natural uranium in the form of $UO_2$, and further indicated that some of the product had been fed back into the process. In a letter dated 8 October 2011, Iran informed the Agency that it had transferred about 1 kg of this $UO_2$ to the R&D section of FMP in order to "conduct research activities and pellet fabrication".

36. **Fuel Manufacturing Plant:** As previously reported, in a DIQ for FMP dated 31 May 2011, Iran informed the Agency that a fresh fuel rod of natural $UO_2$ manufactured at FMP would be shipped to TRR for irradiation and post-irradiation analysis. On 15 October 2011, the Agency carried out an inspection and a DIV at TRR and confirmed that, on 23 August 2011, Iran had started to irradiate a prototype fuel rod containing natural $UO_2$ that had been manufactured at FMP. In a letter dated 30 August 2011, Iran informed the Agency that "for the time being" it had no plans to conduct any destructive testing on the rod and that only non-destructive testing would be conducted at TRR.

37. On 22 October 2011, the Agency carried out an inspection and a DIV at FMP and confirmed that Iran had started to install some equipment for the fabrication of fuel for TRR.[32] During the inspection, the Agency verified five fuel plates containing natural U3O8 that had been produced at the R&D laboratory at FMP for testing purposes.

[31] This was taken from Iran's stockpile of imported UOC (GOV/2003/75, Annex I, para. 8).

[32] GOV/2010/46, para. 26.

## G. Possible Military Dimensions

38. Previous reports by the Director General have identified outstanding issues related to possible military dimensions to Iran's nuclear programme and actions required of Iran to resolve these.[33] Since 2002, the Agency has become increasingly concerned about the possible existence in Iran of undisclosed nuclear related activities involving military related organizations, including activities related to the development of a nuclear payload for a missile, about which the Agency has regularly received new information.

39. The Board of Governors has called on Iran on a number of occasions to engage with the Agency on the resolution of all outstanding issues in order to exclude the existence of possible military dimensions to Iran's nuclear programme.[34] In resolution 1929 (2010), the Security Council reaffirmed Iran's obligations to take the steps required by the Board of Governors in its resolutions GOV/2006/14 and GOV/2009/82, and to cooperate fully with the Agency on all outstanding issues, particularly those which give rise to concerns about the possible military dimensions to Iran's nuclear programme, including by providing access without delay to all sites, equipment, persons and documents requested by the Agency.[35] Since August 2008, Iran has not engaged with the Agency in any substantive way on this matter.

40. The Director General, in his opening remarks to the Board of Governors on 12 September 2011, stated that in the near future he hoped to set out in greater detail the basis for the Agency's concerns so that all Member States would be kept fully informed. In line with that statement, the Annex to this report provides a detailed analysis of the information available to the Agency to date which has given rise to concerns about possible military dimensions to Iran's nuclear programme.

41. The analysis itself is based on a structured and systematic approach to information analysis which the Agency uses in its evaluation of safeguards implementation in all States with comprehensive safeguards agreements in force. This approach involves, inter alia, the identification of indicators of the existence or development of the processes associated with nuclear-related activities, including weaponization.

42. The information which serves as the basis for the Agency's analysis and concerns, as identified in the Annex, is assessed by the Agency to be, overall, credible. The information comes from a wide variety of independent sources, including from a number of Member States, from the Agency's own efforts and from information provided by Iran itself. It is consistent in terms of technical content, individuals and organizations involved, and time frames.

43. The information indicates that Iran has carried out the following activities that are relevant to the development of a nuclear explosive device:

- Efforts, some successful, to procure nuclear related and dual use equipment and materials by military related individuals and entities (Annex, Sections C.1 and C.2);

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[33] GOV/2011/29, para. 35; GOV/2011/7, Attachment; GOV/2010/10, paras. 40-45; GOV/2009/55, paras. 18-25; GOV/2008/38, paras. 14-21; GOV/2008/15, paras. 14-25 and Annex; GOV/2008/4, paras. 35-42.

[34] Most recently in GOV/2009/82 (27 November 2009).

[35] S/RES/1929, paras. 2 and 3.

- Efforts to develop undeclared pathways for the production of nuclear material (Annex, Section C.3);
- The acquisition of nuclear weapons development information and documentation from a clandestine nuclear supply network (Annex, Section C.4); and
- Work on the development of an indigenous design of a nuclear weapon including the testing of components (Annex, Sections C.5-C.12).

44. While some of the activities identified in the Annex have civilian as well as military applications, others are specific to nuclear weapons.

45. The information indicates that prior to the end of 2003 the above activities took place under a structured programme. There are also indications that some activities relevant to the development of a nuclear explosive device continued after 2003, and that some may still be ongoing.

## H. Design Information

46. The modified Code 3.1 of the Subsidiary Arrangements General Part to Iran's Safeguards Agreement provides for the submission to the Agency of design information for new facilities as soon as the decision to construct, or to authorize construction of, a new facility has been taken, whichever is the earlier. The modified Code 3.1 also provides for the submission of fuller design information as the design is developed early in the project definition, preliminary design, construction and commissioning phases. Iran remains the only State with significant nuclear activities in which the Agency is implementing a comprehensive safeguards agreement but which is not implementing the provisions of the modified Code 3.1.[36] The Agency is still awaiting receipt from Iran of updated design information for the IR-40 Reactor, and further information pursuant to statements it has made concerning the planned construction of new uranium enrichment facilities and the design of a reactor similar to TRR.[37]

47. As reported previously, Iran's response to Agency requests for Iran to confirm or provide further information regarding its statements concerning its intention to construct new nuclear facilities is that it would provide the Agency with the required information in "due time" rather than as required by the modified Code 3.1 of the Subsidiary Arrangements General Part to its Safeguards Agreement.[38]

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[36] In accordance with Article 39 of Iran's Safeguards Agreement, agreed Subsidiary Arrangements cannot be changed unilaterally; nor is there a mechanism in the Safeguards Agreement for the suspension of provisions agreed to in the Subsidiary Arrangements. Therefore, as previously explained in the Director General's reports (see e.g. GOV/2007/22, 23 May 2007), the modified Code 3.1, as agreed to by Iran in 2003, remains in force. Iran is further bound by operative paragraph 5 of Security Council resolution 1929 (2010) to "comply fully and without qualification with its IAEA Safeguards Agreement, including through the application of modified Code 3.1".

[37] GOV/2010/46, para. 32.

[38] See para. 27 of this report and GOV/2011/29, para. 37.

## I. Additional Protocol

48. Contrary to the relevant resolutions of the Board of Governors and the Security Council, Iran is not implementing its Additional Protocol. The Agency will not be in a position to provide credible assurance about the absence of undeclared nuclear material and activities in Iran unless and until Iran provides the necessary cooperation with the Agency, including by implementing its Additional Protocol.[39]

## J. Other Matters

49. In August 2011, the Agency carried out a PIV at the Jabr Ibn Hayan Multipurpose Research Laboratory (JHL) to verify, inter alia, nuclear material, in the form of natural uranium metal and process waste, related to the conversion experiments carried out by Iran between 1995 and 2002.[40,41] The Agency's measurement of this material was 19.8 kg less than the operator's declaration of 270.7 kg. In a letter dated 2 November 2011, Iran provided additional information on this matter. The Agency is working with Iran to try to resolve this discrepancy.

50. As previously reported, in a letter dated 19 June 2011, Iran informed the Agency of its intention to "transfer some of spent fuel assemblies (HEU [high enriched uranium] Control Fuel Element (CFE) and Standard Fuel Element (SFE)) from spent fuel pool (KMPE) to reactor core (KMPB) in order to conduct a research project". As of 15 October 2011, this activity had yet to begin.

51. On 2 and 3 October 2011, the Agency carried out an inspection at the Bushehr Nuclear Power Plant, during which the Agency noted that the reactor was in operation. Iran subsequently informed the Agency that the reactor has since been shut down for routine maintenance.

## K. Summary

52. While the Agency continues to verify the non-diversion of declared nuclear material at the nuclear facilities and LOFs declared by Iran under its Safeguards Agreement, as Iran is not providing the necessary cooperation, including by not implementing its Additional Protocol, the Agency is unable to provide credible assurance about the absence of undeclared nuclear material and activities in Iran, and therefore to conclude that all nuclear material in Iran is in peaceful activities.[42]

53. The Agency has serious concerns regarding possible military dimensions to Iran's nuclear programme. After assessing carefully and critically the extensive

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[39] Iran's Additional Protocol was approved by the Board on 21 November 2003 and signed by Iran on 18 December 2003, although it has not been brought into force. Iran provisionally implemented its Additional Protocol between December 2003 and February 2006.

[40] This material had been under Agency seal since 2003.

[41] GOV/2003/75, paras. 20-25 and Annex 1; GOV/2004/34, para. 32, and Annex, paras. 10-12; GOV/2004/60, para. 33, and Annex, paras. 1-7.

[42] The Board has confirmed on numerous occasions, since as early as 1992, that paragraph 2 of INFCIRC/153 (Corr.), which corresponds to Article 2 of Iran's Safeguards Agreement, authorizes and requires the Agency to seek to verify both the non-diversion of nuclear material from declared activities (i.e. correctness) and the absence of undeclared nuclear activities in the State (i.e. completeness) (see, for example, GOV/OR.864, para. 49).

information available to it, the Agency finds the information to be, overall, credible. The information indicates that Iran has carried out activities relevant to the development of a nuclear explosive device. The information also indicates that prior to the end of 2003, these activities took place under a structured programme, and that some activities may still be ongoing.

54. Given the concerns identified above, Iran is requested to engage substantively with the Agency without delay for the purpose of providing clarifications regarding possible military dimensions to Iran's nuclear programme as identified in the Annex to this report.

55. The Agency is working with Iran with a view to resolving the discrepancy identified during the recent PIV at JHL.

56. The Director General urges Iran, as required in the binding resolutions of the Board of Governors and mandatory Security Council resolutions, to take steps towards the full implementation of its Safeguards Agreement and its other obligations, including: implementation of the provisions of its Additional Protocol; implementation of the modified Code 3.1 of the Subsidiary Arrangements General Part to its Safeguards Agreement; suspension of enrichment related activities; suspension of heavy water related activities; and, as referred to above, addressing the Agency's serious concerns about possible military dimensions to Iran's nuclear programme, in order to establish international confidence in the exclusively peaceful nature of Iran's nuclear programme.

57. The Director General will continue to report as appropriate.

## Annex

### Possible Military Dimensions to Iran's Nuclear Programme

1. This Annex consists of three Sections: Section A, which provides an historical overview of the Agency's efforts to resolve questions about the scope and nature of Iran's nuclear programme, in particular regarding concerns about possible military dimensions; Section B, which provides a general description of the sources of information available to the Agency and its assessment of the credibility of that information; and Section C, which reflects the Agency's analysis of the information available to it in the context of relevant indicators of the existence or development of processes associated with nuclear-related activities, including weaponization.

## A. Historical Overview

2. Since late 2002, the Director General has reported to the Board of Governors on the Agency's concerns about the nature of Iran's nuclear programme. Such concerns coincided with the appearance in open sources of information which indicated that Iran was building a large underground nuclear related facility at Natanz and a heavy water production plant at Arak.[1]

3. Between 2003 and 2004, the Agency confirmed a number of significant failures on the part of Iran to meet its obligations under its Safeguards Agreement with respect to the reporting of nuclear material, the processing and use of undeclared nuclear material and the failure to declare facilities where the nuclear material had been received, stored and processed.[2] Specifically, it was discovered that, as early as the late 1970s and early 1980s, and continuing into the 1990s and 2000s, Iran had used undeclared nuclear material for testing and experimentation in several uranium conversion, enrichment, fabrication and irradiation activities, including the separation of plutonium, at undeclared locations and facilities.[3]

4. In October 2003, Iran informed the Director General that it had adopted a policy of full disclosure and had decided to provide the Agency with a full picture of its nuclear activities.[4] Following that announcement, Iran granted the Agency access to locations the Agency requested to visit, provided information and clarifications in relation to the origin of imported equipment and components and made individuals available for interviews. It also continued to implement the modified Code 3.1 of the Subsidiary Arrangements General Part, to which it agreed in February 2003, which provides for the submission of design information on new nuclear facilities as soon as the decision to construct or to authorize construction of such a facility is taken.[5] In November 2003, Iran announced its intention to sign an Additional Protocol to its Safeguards Agreement (which it did in December 2003 following

[1] GOV/2003/40, para. 3.
[2] GOV/2003/40, para. 32; GOV/2003/75, para. 48; GOV/2004/83, paras. 85-86; GOV/2005/67, para. 4.
[3] GOV/2003/75, Annex 1; GOV/2004/83, paras. 85-86.
[4] GOV/2003/75, paras. 13 and 15.
[5] GOV/2003/40, para. 6. Iran stopped implementing the modified Code 3.1 in March 2007 (GOV/2007/22, para. 12).

Board approval of the text), and that, prior to its entry into force, Iran would act in accordance with the provisions of that Protocol.[6]

5. Between 2003 and early 2006, Iran submitted inventory change reports, provided design information with respect to facilities where the undeclared activities had taken place and made nuclear material available for Agency verification. Iran also acknowledged that it had utilized entities with links to the Ministry of Defence in some of its previously undeclared activities.[7] Iran acknowledged that it had had contacts with intermediaries of a clandestine nuclear supply network in 1987 and the early 1990s, and that, in 1987, it had received a handwritten one page document offering assistance with the development of uranium centrifuge enrichment technology, in which reference was also made to a reconversion unit with casting equipment.[8] Iran further acknowledged that it had received a package of information related to centrifuge enrichment technology that also included a 15 page document (hereafter referred to as the "uranium metal document") which Iran said it did not ask for and which describes, inter alia, processes for the conversion of uranium fluoride compounds into uranium metal and the production of hemispherical enriched uranium metallic components.[9]

6. The Agency continued to seek clarification of issues with respect to the scope and nature of Iran's nuclear programme, particularly in light of Iran's admissions concerning its contacts with the clandestine nuclear supply network, information provided by participants in that network and information which had been provided to the Agency by a Member State. This last information, collectively referred to as the "alleged studies documentation", which was made known to the Agency in 2005, indicated that Iran had been engaged in activities involving studies on a so-called green salt project, high explosives testing and the re-engineering of a missile re-entry vehicle to accommodate a new payload.[10] All of this information, taken together, gave rise to concerns about possible military dimensions to Iran's nuclear programme.

7. In August 2007, Iran and the Agency agreed on "Understandings of the Islamic Republic of Iran and the IAEA on the Modalities of Resolution of the Outstanding Issues" (generally referred to as the "work plan") (INFCIRC/711). By February 2008, the four items identified in the work plan as "past outstanding issues", and the two items identified as "other outstanding issues", had been determined by the Agency to be either closed, completed or no longer outstanding.[11] The remaining issues which needed to be clarified by Iran related to the alleged studies, together with other matters which had arisen in the course of resolving the six other issues and which needed to be addressed in connection with the alleged studies,

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[6] GOV/2003/75, para. 18. The Additional Protocol was approved by the Board of Governors on 21 November 2003, and signed on behalf of Iran and the Agency on 18 December 2003 (GOV/2004/11, para. 5). In February 2006, Iran notified the Agency that it would no longer implement the provisions of the Additional Protocol (GOV/2006/15, para. 31).

[7] GOV/2004/11, para. 37.

[8] Iran has stated that the intermediaries offered the reconversion unit with casting equipment on their own initiative, not at the request of the AEOI. Iran also stated that it did not receive the reconversion unit (GOV/2005/67, para. 14).

[9] GOV/2005/87, para. 6; GOV/2007/58, para. 25. Pakistan confirmed, in response to an Agency inquiry, that an identical document existed in Pakistan (GOV/2008/15, para. 24).

[10] GOV/2006/15, para. 38.

[11] GOV/2007/58, paras. 18, 23, 25; GOV/2008/4, paras. 11, 18, 24, 34.

specifically: the circumstances of Iran's acquisition of the uranium metal document, procurement and research and development (R&D) activities of military related institutes and companies that could be nuclear related; and the production of nuclear equipment and components by companies belonging to defence industries.[12]

8. Between February and May 2008, pursuant to the work plan, the Agency shared with Iran information (including documentation) on the alleged studies, and sought clarifications from Iran.[13] In May 2008, Iran submitted to the Agency a 117 page assessment of that information. While Iran confirmed the veracity of some of the information which the Agency had shared with it (such as acknowledgement of names of people, places and organizations), Iran's assessment was focused on deficiencies in form and format, and dismissed the allegations as having been based on "forged" documents and "fabricated" data.[14]

9. The Agency continued to receive additional information from Member States and acquired new information as a result of its own efforts. The Agency tried without success to engage Iran in discussions about the information, and finally wrote to Iran in October 2010 to inform it about this additional information.[15]

10. Between 2007 and 2010, Iran continued to conceal nuclear activities, by not informing the Agency in a timely manner of the decision to construct or to authorize construction of a new nuclear power plant at Darkhovin[16] and a third enrichment facility near Qom (the Fordow Fuel Enrichment Plant).[17,18] The Agency is still awaiting substantive responses from Iran to Agency requests for further information about its announcements, in 2009 and 2010 respectively, that it had decided to construct ten additional enrichment facilities (the locations for five of which had already been identified)[19] and that it possessed laser enrichment technology.[20]

11. The Agency has continued to receive, collect and evaluate information relevant to possible military dimensions to Iran's nuclear programme. As additional information has become available to the Agency, the Agency has been able, notwithstanding Iran's lack of engagement, to refine its analysis of possible military dimensions to Iran's nuclear programme.[21]

## B. Credibility of Information

12. As indicated in paragraph 6 above, among the information available to the Agency is the alleged studies documentation: a large volume of documentation (including correspondence, reports, view graphs from presentations, videos and engineering drawings), amounting to over a thousand pages. The information

[12] GOV/2008/15, paras. 14-15, 25.
[13] GOV/2008/15, para. 16.
[14] GOV/2008/38, para. 15.
[15] GOV/2010/62, paras. 34-35.
[16] GOV/2008/38, para. 11.
[17] GOV/2009/74, paras. 7-17.
[18] GOV/2010/10, para. 31; GOV/2010/28, para. 31; GOV/2010/46, para. 31.
[19] GOV/2010/10, para. 33. In August 2010, Iran informed the Agency that the construction of one of these facilities was to start at the end of the current Iranian year (March 2011) or the beginning of the next year (GOV/2010/46, para. 33).
[20] GOV/2010/46, para. 18.
[21] GOV/2011/54, para. 43.

reflected in that documentation is of a technically complex and interconnected nature, showing research, development and testing activities over time. It also contains working level correspondence consistent with the day to day implementation of a formal programme. Consistent with the Agency's practice, that information has been carefully and critically examined. The Agency has also had several meetings with the Member State to clarify the information it had provided, to question the Member State about the forensics it had carried out on the documentation and the information reflected in it, and to obtain more information on the underlying sources.

13. In addition to the alleged studies documentation, the Agency has received information from more than ten Member States. This has included procurement information, information on international travel by individuals said to have been involved in the alleged activities, financial records, documents reflecting health and safety arrangements, and other documents demonstrating manufacturing techniques for certain high explosive components. This information reinforces and tends to corroborate the information reflected in the alleged studies documentation, and relates to activities substantially beyond those identified in that documentation.

14. In addition to the information referred to in paragraphs 12 and 13 above, the Agency has acquired information as a result of its own efforts, including publications and articles acquired through open source research, satellite imagery, the results of Agency verification activities and information provided by Iran in the context of those verification activities.[22] Importantly, the Agency has also had direct discussions with a number of individuals who were involved in relevant activities in Iran, including, for example, an interview with a leading figure in the clandestine nuclear supply network (see paragraph 35 below). The information obtained by the Agency from the discussions with these individuals is consistent with the information provided by Member States, and that acquired through its own efforts, in terms of time frames and technical content.

15. As indicated in paragraph 8 above, Iran has acknowledged certain information reflected in the alleged studies documentation. However, many of the answers given by Iran to questions posed by the Agency in connection with efforts to resolve the Agency's concerns have been imprecise and/or incomplete, and the information has been slow in coming and sometimes contradictory. This, combined with events such as the dismantling of the Lavisan-Shian site in late 2003/early 2004 (see paragraph 19 below), and a pattern of late or after the fact acknowledgement of the existence of previously undeclared parts of Iran's nuclear programme, have tended to increase the Agency's concerns, rather than dispel them.

16. As indicated above, the information consolidated and presented in this Annex comes from a wide variety of independent sources, including from a number of Member States, from the Agency's own efforts and from information provided by Iran itself. It is overall consistent in terms of technical content, individuals and organizations involved and time frames. Based on these considerations, and in light of the Agency's general knowledge of the Iranian nuclear programme and its historical evolution, the Agency finds the information upon which Part C of this Annex is based to be, overall, credible.

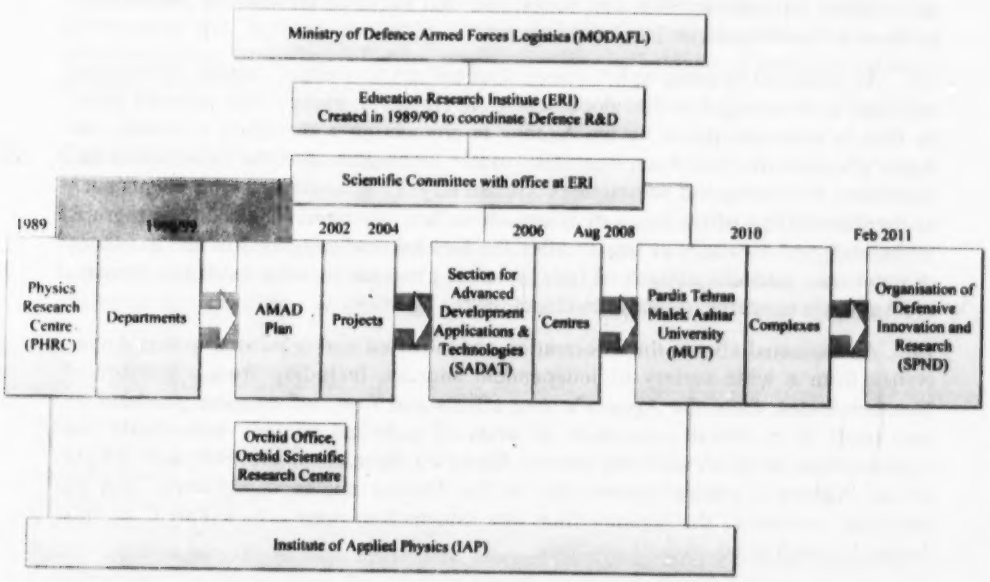
[22] Further specific examples are described below in Section C of this Annex.

## C. Nuclear Explosive Development Indicators

17. Within its nuclear programme, Iran has developed the capability to enrich uranium to a level of up to 20% U-235, declared to be for use as fuel in research reactors. In the absence of any indicators that Iran is currently considering reprocessing irradiated nuclear fuel to extract plutonium,[23] the Agency has, to date, focused its analysis of Iran's nuclear programme on an acquisition path involving high enriched uranium (HEU). Based on indicators observed by the Agency in connection with Iran's nuclear activities, the Agency's work has concentrated on an analysis pertinent to the development of an HEU implosion device.

### C.1. Programme management structure

18. The Agency has been provided with information by Member States which indicates that the activities referred to in Sections C.2 to C.12 were, at least for some significant period of time, managed through a programme structure, assisted by advisory bodies, and that, owing to the importance of these efforts, senior Iranian figures featured within this command structure. From analysis of this information and information provided by Iran, and through its own endeavours, the Agency has been able to construct what it believes to be a good understanding of activities undertaken by Iran prior to the end of 2003. The Agency's ability to construct an equally good understanding of activities in Iran after the end of 2003 is reduced, due to the more limited information available to the Agency. For ease of reference, the figure below depicts, in summary form, what the Agency understands of the programme structure, and administrative changes in that structure over the years. Attachment 1 to this Annex provides further details, derived from that information, about the organizational arrangements and projects within that programme structure.




[23] Nevertheless, there are, and have been in the past, activities in Iran relevant to the production of plutonium.

19. The Agency received information from Member States which indicates that, sometime after the commencement by Iran in the late 1980s of covert procurement activities,[24] organizational structures and administrative arrangements for an undeclared nuclear programme were established and managed through the Physics Research Centre (PHRC), and were overseen, through a Scientific Committee, by the Defence Industries Education Research Institute (ERI), established to coordinate defence R&D for the Ministry of Defence Armed Forces Logistics (MODAFL). Iran has confirmed that the PHRC was established in 1989 at Lavisan-Shian, in Tehran. Iran has stated that the PHRC was created with the purpose of "preparedness to combat and neutralization of casualties due to nuclear attacks and accidents (nuclear defence) and also support and provide scientific advice and services to the Ministry of Defence". Iran has stated further that those activities were stopped in 1998.[25] In late 2003/early 2004, Iran completely cleared the site.[26]

20. According to information provided by Member States, by the late 1990s or early 2000s, the PHRC activities were consolidated under the "AMAD Plan". Mohsen Fakhrizadeh (Mahabadi) was the Executive Officer of the AMAD Plan, the executive affairs of which were performed by the "Orchid Office".[27] Most of the activities carried out under the AMAD Plan appear to have been conducted during 2002 and 2003.

21. The majority of the details of the work said to have been conducted under the AMAD Plan come from the alleged studies documentation which, as indicated in paragraph 6 above, refer to studies conducted in three technical areas: the green salt project; high explosives (including the development of exploding bridgewire detonators); and re-engineering of the payload chamber of the Shahab 3 missile re-entry vehicle.

22. According to the Agency's assessment of the information contained in that documentation, the green salt project (identified as Project 5.13) was part of a larger project (identified as Project 5) to provide a source of uranium suitable for use in an undisclosed enrichment programme. The product of this programme would be converted into metal for use in the new warhead which was the subject of the missile re-entry vehicle studies (identified as Project 111). As of May 2008, the Agency was not in a position to demonstrate to Iran the connection between Project 5 and Project 111. However, subsequently, the Agency was shown documents which established a connection between Project 5 and Project 111, and hence a link between nuclear material and a new payload development programme.

23. Information the Agency has received from Member States indicates that, owing to growing concerns about the international security situation in Iraq and neighbouring countries at that time, work on the AMAD Plan was stopped rather

[24] GOV/2004/83; GOV/2003/75, Annex 1.

[25] At which time, according to Iran, the centre was changed to the Biological Studies Centre. Iran also stated that, in 2002, the Institute of Applied Physics (IAP) was also located at that site, and that, although some of the biological activities continued there, the main objective was to use the capabilities of universities in Iran (in particular at the Malek Ashtar University near Esfahan) for the education and R&D needs of the Ministry of Defence (GOV/2004/83, paras. 100-101).

[26] According to Iran, the site was cleared in 2003/2004 in order to return the land to the local municipality (GOV/2004/60, paras. 42-46; GOV/2004/83, paras. 96-105).

[27] Possibly so named because one of the locations used by the AMAD Plan was on Orchid Street in Tehran.

abruptly pursuant to a "halt order" instruction issued in late 2003 by senior Iranian officials. According to that information, however, staff remained in place to record and document the achievements of their respective projects. Subsequently, equipment and work places were either cleaned or disposed of so that there would be little to identify the sensitive nature of the work which had been undertaken.

24. The Agency has other information from Member States which indicates that some activities previously carried out under the AMAD Plan were resumed later, and that Mr. Fakhrizadeh retained the principal organizational role, first under a new organization known as the Section for Advanced Development Applications and Technologies (SADAT),[28] which continued to report to MODAFL, and later, in mid-2008, as the head of the Malek Ashtar University of Technology (MUT) in Tehran.[29] The Agency has been advised by a Member State that, in February 2011, Mr. Fakhrizadeh moved his seat of operations from MUT to an adjacent location known as the Modjeh Site, and that he now leads the Organization of Defensive Innovation and Research.[30] The Agency is concerned because some of the activities undertaken after 2003 would be highly relevant to a nuclear weapon programme.

### C.2. Procurement activities

25. Under the AMAD Plan, Iran's efforts to procure goods and services allegedly involved a number of ostensibly private companies which were able to provide cover for the real purpose of the procurements. The Agency has been informed by several Member States that, for instance, Kimia Maadan was a cover company for chemical engineering operations under the AMAD Plan while also being used to help with procurement for the Atomic Energy Organization of Iran (AEOI).[31]

26. In addition, throughout the entire timeline, instances of procurement and attempted procurement by individuals associated with the AMAD Plan of equipment, materials and services which, although having other civilian applications, would be useful in the development of a nuclear explosive device, have either been uncovered by the Agency itself or been made known to it.[32] Among such equipment, materials and services are: high speed electronic switches and spark gaps (useful for triggering and firing detonators); high speed cameras (useful in experimental diagnostics); neutron sources (useful for calibrating neutron measuring equipment); radiation detection and measuring equipment (useful in a nuclear material production environment); and training courses on topics relevant to nuclear explosives development (such as neutron cross section calculations and shock wave interactions/hydrodynamics).

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[28] The information indicates that SADAT consisted of at least seven centres, each responsible for carrying out specific R&D work. The activities were established as overt work applicable to conventional military activities, some with possible nuclear applications. The work in the SADAT Centres drew on resources at Iranian universities which had laboratories available to them and students to do the research.

[29] The information indicates that, in his new role, Mr. Fakhrizadeh merged the SADAT Centres into complexes within MUT, known as "Pardis Tehran".

[30] Known from its Farsi initials as "SPND".

[31] GOV/2008/4, para. 32; GOV/2006/15, para. 39.

[32] GOV/2008/4, para. 40.

### C.3. Nuclear material acquisition

27. In 2008, the Director General informed the Board that: the Agency had no information at that time — apart from the uranium metal document — on the actual design or manufacture by Iran of nuclear material components of a nuclear weapon or of certain other key components, such as initiators, or on related nuclear physics studies,[33] and that it had not detected the actual use of nuclear material in connection with the alleged studies.[34]

28. However, as indicated in paragraph 22 above, information contained in the alleged studies documentation suggests that Iran was working on a project to secure a source of uranium suitable for use in an undisclosed enrichment programme, the product of which would be converted into metal for use in the new warhead which was the subject of the missile re-entry vehicle studies. Additional information provided by Member States indicates that, although uranium was not used, kilogram quantities of natural uranium metal were available to the AMAD Plan.

29. Information made available to the Agency by a Member State, which the Agency has been able to examine directly, indicates that Iran made progress with experimentation aimed at the recovery of uranium from fluoride compounds (using lead oxide as a surrogate material to avoid the possibility of uncontrolled contamination occurring in the workplace).

30. In addition, although now declared and currently under safeguards, a number of facilities dedicated to uranium enrichment (the Fuel Enrichment Plant and Pilot Fuel Enrichment Plant at Natanz and the Fordow Fuel Enrichment Plant near Qom) were covertly built by Iran and only declared once the Agency was made aware of their existence by sources other than Iran. This, taken together with the past efforts by Iran to conceal activities involving nuclear material, create more concern about the possible existence of undeclared nuclear facilities and material in Iran.

### C.4. Nuclear components for an explosive device

31. For use in a nuclear device, HEU retrieved from the enrichment process is first converted to metal. The metal is then cast and machined into suitable components for a nuclear core.

32. As indicated in paragraph 5 above, Iran has acknowledged that, along with the handwritten one page document offering assistance with the development of uranium centrifuge enrichment technology, in which reference is also made to a reconversion unit with casting equipment, Iran also received the uranium metal document which describes, inter alia, processes for the conversion of uranium compounds into uranium metal and the production of hemispherical enriched uranium metallic components.

33. The uranium metal document is known to have been available to the clandestine nuclear supply network that provided Iran with assistance in developing its centrifuge enrichment capability, and is also known to be part of a larger package of information which includes elements of a nuclear explosive design. A similar package of information, which surfaced in 2003, was provided by the same network

[33] GOV/2008/15, para. 24.

[34] GOV/2008/38, para. 21.

to Libya.[35] The information in the Libyan package, which was first reviewed by Agency experts in January 2004, included details on the design and construction of, and the manufacture of components for, a nuclear explosive device.[36]

34. In addition, a Member State provided the Agency experts with access to a collection of electronic files from seized computers belonging to key members of the network at different locations. That collection included documents seen in Libya, along with more recent versions of those documents, including an up-dated electronic version of the uranium metal document.

35. In an interview in 2007 with a member of the clandestine nuclear supply network, the Agency was told that Iran had been provided with nuclear explosive design information. From information provided to the Agency during that interview, the Agency is concerned that Iran may have obtained more advanced design information than the information identified in 2004 as having been provided to Libya by the nuclear supply network.

36. Additionally, a Member State provided information indicating that, during the AMAD Plan, preparatory work, not involving nuclear material, for the fabrication of natural and high enriched uranium metal components for a nuclear explosive device was carried out.

37. As the conversion of HEU compounds into metal and the fabrication of HEU metal components suitable in size and quality are steps in the development of an HEU nuclear explosive device, clarification by Iran is needed in connection with the above.

### C.5. Detonator development

38. The development of safe, fast-acting detonators, and equipment suitable for firing the detonators, is an integral part of a programme to develop an implosion type nuclear device. Included among the alleged studies documentation are a number of documents relating to the development by Iran, during the period 2002-2003, of fast functioning detonators, known as "exploding bridgewire detonators" or "EBWs" as safe alternatives to the type of detonator described for use in the nuclear device design referred to in paragraph 33 above.

39. In 2008, Iran told the Agency that it had developed EBWs for civil and conventional military applications and had achieved a simultaneity of about one microsecond when firing two to three detonators together,[37] and provided the Agency with a copy of a paper relating to EBW development work presented by two Iranian researchers at a conference held in Iran in 2005. A similar paper was published by the two researchers at an international conference later in 2005.[38] Both papers indicate that suitable high voltage firing equipment had been acquired or developed by Iran. Also in 2008, Iran told the Agency that, before the period 2002-2004, it had already achieved EBW technology. Iran also provided the Agency with

[35] The same network was also the source of an unsolicited offer to Iraq in 1990 for the provision of information dealing with centrifuge enrichment and nuclear weapon manufacturing (GOV/INF/1998/6, Section B.3).

[36] GOV/2004/11, para. 77; GOV/2004/12, paras. 30-32.

[37] GOV/2008/15, para. 20.

[38] The authors of the papers have affiliations to Malek Ashtar University and the Air Defence Industries Group of Tehran.

a short undated document in Farsi, understood to be the specifications for a detonator development programme, and a document from a foreign source showing an example of a civilian application in which detonators are fired simultaneously. However, Iran has not explained to the Agency its own need or application for such detonators.

40. The Agency recognizes that there exist non-nuclear applications, albeit few, for detonators like EBWs, and of equipment suitable for firing multiple detonators with a high level of simultaneity. Notwithstanding, given their possible application in a nuclear explosive device, and the fact that there are limited civilian and conventional military applications for such technology, Iran's development of such detonators and equipment is a matter of concern, particularly in connection with the possible use of the multipoint initiation system referred to below.

### C.6. Initiation of high explosives and associated experiments

41. Detonators provide point source initiation of explosives, generating a naturally diverging detonation wave. In an implosion type nuclear explosive device, an additional component, known as a multipoint initiation system, can be used to reshape the detonation wave into a converging smooth implosion to ensure uniform compression of the core fissile material to supercritical density.[39]

42. The Agency has shared with Iran information provided by a Member State which indicates that Iran has had access to information on the design concept of a multipoint initiation system that can be used to initiate effectively and simultaneously a high explosive charge over its surface.[40] The Agency has been able to confirm independently that such a design concept exists and the country of origin of that design concept. Furthermore, the Agency has been informed by nuclear-weapon States that the specific multipoint initiation concept is used in some known nuclear explosive devices. In its 117 page submission to the Agency in May 2008, Iran stated that the subject was not understandable to Iran and that Iran had not conducted any activities of the type referred to in the document.

43. Information provided to the Agency by the same Member State referred to in the previous paragraph describes the multipoint initiation concept referred to above as being used by Iran in at least one large scale experiment in 2003 to initiate a high explosive charge in the form of a hemispherical shell. According to that information, during that experiment, the internal hemispherical curved surface of the high explosive charge was monitored using a large number of optical fibre cables, and the light output of the explosive upon detonation was recorded with a high speed streak camera. It should be noted that the dimensions of the initiation system and the explosives used with it were consistent with the dimensions for the new payload which, according to the alleged studies documentation, were given to the engineers who were studying how to integrate the new payload into the chamber of the Shahab 3 missile re-entry vehicle (Project 111) (see Section C.11 below). Further information provided to the Agency by the same Member State indicates that the large scale high explosive experiments were conducted by Iran in the region of Marivan.

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[39] "Supercritical" density is one at which fissionable material is able to sustain a chain reaction in such a manner that the rate of reaction increases.

[40] GOV/2008/15, Annex, Section A.2, Document 3.

44. The Agency has strong indications that the development by Iran of the high explosives initiation system, and its development of the high speed diagnostic configuration used to monitor related experiments, were assisted by the work of a foreign expert who was not only knowledgeable in these technologies, but who, a Member State has informed the Agency, worked for much of his career with this technology in the nuclear weapon programme of the country of his origin. The Agency has reviewed publications by this foreign expert and has met with him. The Agency has been able to verify through three separate routes, including the expert himself, that this person was in Iran from about 1996 to about 2002, ostensibly to assist Iran in the development of a facility and techniques for making ultra-dispersed diamonds ("UDDs" or "nanodiamonds"), where he also lectured on explosion physics and its applications.

45. Furthermore, the Agency has received information from two Member States that, after 2003, Iran engaged in experimental research involving a scaled down version of the hemispherical initiation system and high explosive charge referred to in paragraph 43 above, albeit in connection with non-nuclear applications. This work, together with other studies made known to the Agency in which the same initiation system is used in cylindrical geometry, could also be relevant to improving and optimizing the multipoint initiation design concept relevant to nuclear applications.

46. The Agency's concern about the activities described in this Section derives from the fact that a multipoint initiation system, such as that described above, can be used in a nuclear explosive device. However, Iran has not been willing to engage in discussion of this topic with the Agency.

### C.7. Hydrodynamic experiments

47. One necessary step in a nuclear weapon development programme is determining whether a theoretical design of an implosion device, the behaviour of which can be studied through computer simulations, will work in practice. To that end, high explosive tests referred to as "hydrodynamic experiments" are conducted in which fissile and nuclear components may be replaced with surrogate materials.[41]

48. Information which the Agency has been provided by Member States, some of which the Agency has been able to examine directly, indicates that Iran has manufactured simulated nuclear explosive components using high density materials such as tungsten. These components were said to have incorporated small central cavities suitable for the insertion of capsules such as those described in Section C.9 below. The end use of such components remains unclear, although they can be linked to other information received by the Agency concerning experiments involving the use of high speed diagnostic equipment, including flash X ray, to monitor the symmetry of the compressive shock of the simulated core of a nuclear device.

[41] Hydrodynamic experiments can be designed to simulate the first stages of a nuclear explosion. In such experiments, conventional high explosives are detonated to study the effects of the explosion on specific materials. The term "hydrodynamic" is used because material is compressed and heated with such intensity that it begins to flow and mix like a fluid, and "hydrodynamic equations" are used to describe the behaviour of fluids.

49. Other information which the Agency has been provided by Member States indicates that Iran constructed a large explosives containment vessel in which to conduct hydrodynamic experiments. The explosives vessel, or chamber, is said to have been put in place at Parchin in 2000. A building was constructed at that time around a large cylindrical object at a location at the Parchin military complex. A large earth berm was subsequently constructed between the building containing the cylinder and a neighbouring building, indicating the probable use of high explosives in the chamber. The Agency has obtained commercial satellite images that are consistent with this information. From independent evidence, including a publication by the foreign expert referred to in paragraph 44 above, the Agency has been able to confirm the date of construction of the cylinder and some of its design features (such as its dimensions), and that it was designed to contain the detonation of up to 70 kilograms of high explosives, which would be suitable for carrying out the type of experiments described in paragraph 43 above.

50. As a result of information the Agency obtained from a Member State in the early 2000s alleging that Iran was conducting high explosive testing, possibly in association with nuclear materials, at the Parchin military complex, the Agency was permitted by Iran to visit the site twice in 2005. From satellite imagery available at that time, the Agency identified a number of areas of interest, none of which, however, included the location now believed to contain the building which houses the explosives chamber mentioned above; consequently, the Agency's visits did not uncover anything of relevance.

51. Hydrodynamic experiments such as those described above, which involve high explosives in conjunction with nuclear material or nuclear material surrogates, are strong indicators of possible weapon development. In addition, the use of surrogate material, and/or confinement provided by a chamber of the type indicated above, could be used to prevent contamination of the site with nuclear material. It remains for Iran to explain the rationale behind these activities.

### C.8. Modelling and calculations

52. Information provided to the Agency by two Member States relating to modelling studies alleged to have been conducted in 2008 and 2009 by Iran is of particular concern to the Agency. According to that information, the studies involved the modelling of spherical geometries, consisting of components of the core of an HEU nuclear device subjected to shock compression, for their neutronic behaviour at high density, and a determination of the subsequent nuclear explosive yield. The information also identifies models said to have been used in those studies and the results of these calculations, which the Agency has seen. The application of such studies to anything other than a nuclear explosive is unclear to the Agency. It is therefore essential that Iran engage with the Agency and provide an explanation.

53. The Agency obtained information in 2005 from a Member State indicating that, in 1997, representatives from Iran had met with officials from an institute in a nuclear-weapon State to request training courses in the fields of neutron cross section calculations using computer codes employing Monte Carlo methodology, and shock wave interactions with metals. In a letter dated 14 May 2008, Iran advised the Agency that there was nothing to support this information. The Agency has also been provided with information by a Member State indicating that, in 2005, arrangements were made in Iran for setting up projects within SADAT centres (see

Section C.1 and Attachment 1), inter alia, to establish a databank for "equation of state" information[42] and a hydrodynamics calculation centre. The Agency has also been provided with information from a different Member State that, in 2005, a senior official in SADAT solicited assistance from Shahid Behesti University in connection with complex calculations relating to the state of criticality of a solid sphere of uranium being compressed by high explosives.

54. Research by the Agency into scientific literature published over the past decade has revealed that Iranian workers, in particular groups of researchers at Shahid Behesti University and Amir Kabir University, have published papers relating to the generation, measurement and modelling of neutron transport.[43] The Agency has also found, through open source research, other Iranian publications which relate to the application of detonation shock dynamics to the modelling of detonation in high explosives, and the use of hydrodynamic codes in the modelling of jet formation with shaped (hollow) charges. Such studies are commonly used in reactor physics or conventional ordnance research,[44] but also have applications in the development of nuclear explosives.

### C.9. Neutron initiator

55. The Agency has information from a Member State that Iran has undertaken work to manufacture small capsules suitable for use as containers of a component containing nuclear material. The Agency was also informed by a different Member State that Iran may also have experimented with such components in order to assess their performance in generating neutrons. Such components, if placed in the centre of a nuclear core of an implosion type nuclear device and compressed, could produce a burst of neutrons suitable for initiating a fission chain reaction. The location where the experiments were conducted was said to have been cleaned of contamination after the experiments had taken place. The design of the capsule, and the material associated with it, are consistent with the device design information which the clandestine nuclear supply network allegedly provided to Iran.

56. The Agency also has information from a Member State that work in this technical area may have continued in Iran after 2004, and that Iran embarked on a four year programme, from around 2006 onwards, on the further validation of the design of this neutron source, including through the use of a non-nuclear material to avoid contamination.

57. Given the importance of neutron generation and transport, and their effect on geometries containing fissile materials in the context of an implosion device, Iran needs to explain to the Agency its objectives and capabilities in this field.

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[42] An "equation of state" is a thermodynamic equation describing the state of matter under a given set of physical conditions (such as temperature, pressure, volume or internal energy).

[43] The modelling of neutron transport refers to the study of the motions and interactions of neutrons with materials which are used to see where they are and in what direction and at what speed they are going.

[44] For example, the shaped (hollow) charge studies said by Member States to have been carried out by the Centre for Research and Development of Explosion and Shock Technology, also known as "METFAZ", have conventional military applications (such as for developing armour piercing projectiles), but can also be used to develop computer codes which can then be adapted to model nuclear explosives.

### C.10. Conducting a test

58. The Agency has information provided by a Member State that Iran may have planned and undertaken preparatory experimentation which would be useful were Iran to carry out a test of a nuclear explosive device. In particular, the Agency has information that Iran has conducted a number of practical tests to see whether its EBW firing equipment would function satisfactorily over long distances between a firing point and a test device located down a deep shaft. Additionally, among the alleged studies documentation provided by that Member State, is a document, in Farsi, which relates directly to the logistics and safety arrangements that would be necessary for conducting a nuclear test. The Agency has been informed by a different Member State that these arrangements directly reflect those which have been used in nuclear tests conducted by nuclear-weapon States.

### C.11. Integration into a missile delivery vehicle

59. The alleged studies documentation contains extensive information regarding work which is alleged to have been conducted by Iran during the period 2002 to 2003 under what was known as Project 111. From that information, the project appears to have consisted of a structured and comprehensive programme of engineering studies to examine how to integrate a new spherical payload into the existing payload chamber which would be mounted in the re-entry vehicle of the Shahab 3 missile.

60. According to that documentation, using a number of commercially available computer codes, Iran conducted computer modelling studies of at least 14 progressive design iterations of the payload chamber and its contents to examine how they would stand up to the various stresses that would be encountered on being launched and travelling on a ballistic trajectory to a target. It should be noted that the masses and dimensions of components identified in information provided to the Agency by Member States that Iran is alleged to have been developing (see paragraphs 43 and 48 above) correspond to those assessed to have been used in Project 111 engineering studies on the new payload chamber.

61. During these studies, prototype components were allegedly manufactured at workshops known to exist in Iran but which Iran refused the Agency permission to visit. The six engineering groups said to have worked under Project 111 produced many technical reports, which comprise a substantial part of the alleged studies documentation. The Agency has studied these reports extensively and finds that they are both internally consistent and consistent with other supporting information related to Project 111.

62. The alleged studies documentation also shows that, as part of the activities undertaken within Project 111, consideration was being given to subjecting the prototype payload and its chamber to engineering stress tests to see how well they would stand up in practice to simulated launch and flight stresses (so-called "environmental testing"). This work would have complemented the engineering modelling simulation studies referred to in paragraph 60 above. According to the information reflected in the alleged studies documentation, within Project 111, some, albeit limited, preparations were also being undertaken to enable the assembly of manufactured components.

63. Iran has denied conducting the engineering studies, claiming that the documentation which the Agency has is in electronic format and so could have been manipulated, and that it would have been easy to fabricate.[45] However, the quantity of the documentation, and the scope and contents of the work covered in the documentation, are sufficiently comprehensive and complex that, in the Agency's view, it is not likely to have been the result of forgery or fabrication. While the activities described as those of Project 111 may be relevant to the development of a non-nuclear payload, they are highly relevant to a nuclear weapon programme.

### C.12. Fuzing, arming and firing system

64. The alleged studies documentation indicates that, as part of the studies carried out by the engineering groups under Project 111 to integrate the new payload into the re-entry vehicle of the Shahab 3 missile, additional work was conducted on the development of a prototype firing system that would enable the payload to explode both in the air above a target, or upon impact of the re-entry vehicle with the ground. Iran was shown this information, which, in its 117 page submission (referred to above in paragraph 8), it dismissed as being "an animation game".

65. The Agency, in conjunction with experts from Member States other than those which had provided the information in question, carried out an assessment of the possible nature of the new payload. As a result of that assessment, it was concluded that any payload option other than nuclear which could also be expected to have an airburst option (such as chemical weapons) could be ruled out. Iran was asked to comment on this assessment and agreed in the course of a meeting with the Agency which took place in Tehran in May 2008 that, if the information upon which it was based were true, it would constitute a programme for the development of a nuclear weapon. Attachment 2 to this Annex reproduces the results of the Agency's assessment as it was presented by the Secretariat to the Member States in the technical briefing which took place in February 2008.

[45] GOV/2008/15, para. 22.

**Attachment 1: List of Departments, Projects and Centres**

| PHRC Departments | AMAD Plan Projects | SADAT Centres |
|---|---|---|
| Department 01 Nuclear Physics | Project 110 Payload Design | Centre for Readiness & New Defence Technologies |
| Department 02 Centrifuge Enrichment | Project 111 Payload Integration | Centre for R&D (1) of Explosion & Shock Technology |
| Department 03 Laser Enrichment | Project 3 Manufacture of Components | Centre for Industrial Research & Construction |
| Department 04 Uranium Conversion | 3.12 Explosives and EBW detonator | Centre for R&T (2) of Advanced Materials – Chemistry |
| Department 05 Geology | 3.14 Uranium metallurgy | Centre for R&T of Advanced Materials – Metallurgy |
| Department 06 Health Physics | Project 4 Uranium Enrichment | Centre for R&D of New Aerospace Technology |
| Department 07 Workshop | Project 5 Uranium Mining, Concentration & Conversion | Centre for Laser & Photonics Applications |
| Department 08 Heavy Water | 5.13 Green Salt Project | |
| Department 09 Analytical Laboratory | 5.15 Gchine Mine Project | |
| Department 10 Computing | Projects 8, 9 and 10 | |
| Department 20 Analysis | Project Health and Safety | |
| | Project 19 Involvement of IAP | |
| | Project/Group 117 Procurement and Supply | |

(1) R&D = Research & Development
(2) R&T = Research & Technology

**Attachment 2: Analysis of Payload**